

**An Updated Association Between Food Insecurity and Diabetes: National
Health and Nutrition Examination Survey (NAHNES) 2013-2014**

An Honors Thesis (HONR 499)

by

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Abstract

Food insecurity is extremely problematic in today's society. The constant fear of being without food for yourself and/or your children can cause a significant impact on one's home life. Not having much money for food, families often rely on cheap meals filled with high calories to keep their stomachs satisfied until the next meal. By doing this, more and more people are developing diabetes because of the unhealthy eating habits. By using the most recent data from the 2013-2014 National Health and Nutrition Examination Survey (NHANES), linear regression models were analyzed to figure out if there was an association between food insecurity and diabetes. This research was an updated analysis of *Food Insecurity is Associated with Diabetes Mellitus: Results from the National Health Examination and Nutrition Examination Survey (NHANES) 1999-2002* by Seligman et al. The data used in this updated assessment consisted of 3,650 participants over the age of 20 who had an income to poverty ratio less than 300 percent. After multiple linear regression analyses, it was found that there was a significant association between food security and diabetes after adjusting for a variety of variables.

Acknowledgments

I would like to thank my instructor, Crystal Lorch, for advising me through this project. Her help and encouragement throughout the year made this process less intimidating.

Process Analysis Statement

In the introduction, I explain that this research project is focused on analyzing the connection and correlation between food insecurity and obesity, as well as food insecurity and diabetes. In order to help readers gain a better understanding of this research project, I have elaborated on some of the technical terms and processes used in my paper.

SAS 9.3 is a type of statistical software that I have used in a few math classes while here at Ball State. It is very useful for data management, analytics, and multivariate analyses.

Throughout this paper you will see that I constantly refer to $\alpha=0.05$. This is the predetermined significance level, and it is the probability of rejecting the null hypothesis when it is actually true. We try to keep this as low as possible, but 0.05 is typically used.

Chi-square tests are used to determine if there is a difference between the expected frequencies and the observed frequencies in one or more determined categories. Thus, when I was determining the correlation between food security and obesity, it was important to use the Chi-square test because I had to adjust for so many different variables.

I also use a lot of regression analysis to determine correlation between variables. Regression analysis is the process of examining if independent variables are related to dependent variables.

The null hypothesis is what I am testing against. One example of a null hypothesis will be that there is no association between food security and obesity. This is the null hypothesis because there is **no** association between the two populations. Likewise, the alternative hypothesis is what I am wanting to test. So throughout this paper I am trying to determine if there is any association between these issues, therefore, the alternative hypothesis would be there **is** an association between food security and obesity.

I determine whether or not we can reject the hypothesis or not by looking at the p-value that is computed from the regression analysis. The p-value represents the strength of the evidence **against** the null hypothesis. If $p < \alpha$, I reject the null hypothesis because there is strong evidence against the null hypothesis. If $p > \alpha$, I fail to reject the null hypothesis because there is weak evidence against the null hypothesis. A 95% confidence interval (95% CI) is typically given along with the p-value to show a certain range for most of the data. The smaller the range of the confidence interval, the more stable the estimate. If a wide confidence interval is present, it means the estimate is less stable.

When I talk about odds ratio, this is the odds of a particular outcome happening given specific elements are present, like severe food insecurity, compared to the outcome without the specific elements.

The process of my research was pretty simple. I got all of my data from the NHANES website, and specifically looked at the dataset from 2013-2014. Looking at this data was overwhelming. There were an abundance of sections filled with a variety of questions, and so it was a lot to take in at first. Luckily, I had the paper written by Seligman et al. to refer to for guidance. After reviewing the paper many times, I knew which data I wanted to pull from the questionnaires. After this I started working with SAS to help combine all of the data into one dataset that I could work with. Once I combined the data, I started performing the regression analysis that will be further explained in the paper.

Throughout this research project I learned a lot about myself. I learned that I am a very visual learner, and this is something I need to keep in mind as I start graduate school. There were many times I had to look back at old PowerPoints to understand what test statistic I should be looking for because so many were present when doing regression analysis. I also had to

remember how to properly word all of the odds ratio explanations because there is very specific verbiage for it. I also learned that it's okay to not meet every deadline. This year was filled with long days and weekends full of school work, studying, and projects. When you add the stress and busy schedule of outside organizations, sometimes this thesis went to the bottom of the list of "things to do." However, when that happened, I made sure I made up for it with the extra time I was given. My drive and determination to finish this project were strong as I powered through the results and conclusion.

Overall, this project was very interesting and fun to work on. However, sometimes it would get really frustrating. Anyone who has ever worked with any type of coding has probably had those moments when something isn't working right, but you don't know why. This happened a few times for me. Sometimes I would get an error in SAS, but I didn't know what the problem was. I would research online to help find a solution, or I would look in my old class notes. Sometimes it would be as simple as a misspelled word, or a forgotten semicolon. This would be frustrating at times, but I learned to be patient with myself and the program.

Introduction

According to the United States Department of Agriculture, a food insecure household is one that is uncertain of having or unable to acquire enough food to meet the needs of all the members because they have insufficient money or other resources for food. Most times for low food security households, they have to “disrupt their eating patterns or reduce intake by using a variety of coping strategies, such as eating less varied diets, participating in Federal food assistance programs, or getting emergency food from community food pantries” (Key Statistics and Graphics). Although food insecurity rates are decreasing, there is still a major concern for those households that are not getting the necessary nutrients. With lives seemingly becoming more hectic, it is only too simple to swing by a fast food restaurant and pick up a meal. As a bonus, that meal is typically under \$10.

One might think that someone who is food insecure would weigh less because they do not eat as often. However, this is incorrect. Those that are food insecure typically have an increased BMI because the foods they are eating are not nutrient dense, but rather high in calories. Here is when we go back to eating at fast food restaurants. Some families depend on buying large amounts of food for a lower price so that they can try and keep their family sufficiently full. When shopping at the grocery store for a nutritionally balanced meal, one might think that the price of their groceries is more expensive than normal. For some families, why would you buy fresh fruit and veggies that only last a day when you could buy frozen meals and pizzas? The latter typically lasts longer, and it is cheaper. According to a study done by the Harvard School of Public Health, researchers found that healthier diet patterns cost significantly more than unhealthy diets. On average, “a day’s worth of the most healthy diet patterns for one person cost about \$1.50 more per day than the least healthy ones” (Mayo Clinic Staff). For a food insecure

household, eating healthy food is not as much of a priority. Their main concern is making sure everyone is fed, period.

I wanted to do this project because I wanted to expand upon the programming and statistical analysis practice I got over the summer at Boston University and here at Ball State. This past summer I attended the Summer Institute of Biostatistics (SIBS) at Boston University. Here I learned about the different kinds of research one can do as a biostatistician, as we had different faculty and staff members present on some of their research. During this course, we used data from the National Health and Nutrition Examination Survey (NHANES) to supplement some of our homework assignments using the computer program SAS. After the SIBS program finished, I made the decision that I wanted to get my PhD in biostatistics. This project will help me prepare for graduate school and give me more research experience. I also find this topic really interesting, as it is comparing two things I had never thought about comparing before; food security and disease. This project will allow me to practice my programming skills in SAS, and it will help me enhance my discussion about the results and how to format them in an educational and scientific way.

Although I wanted to expand my research skills, I also chose this topic because it is something that affects us right here, right now, in Delaware County. According to the United States Census Bureau, 22% of Delaware County residents are below the poverty level. When you combine that with the fact that there are many food deserts in Delaware County, this information is alarming. Although organizations such as Second Harvest Food Bank are trying to combat this, there are still a lot of people who need help. Not only is food insecurity a huge problem, but the effect of diabetes is overwhelming. "Type 2 diabetes affects your body's ability to produce insulin" (Pietrangelo). Someone with diabetes has an increased risk of having a stroke, cataracts,

and heart disease. My project is really meaningful because it ties together these two major issues of food insecurity and diabetes.

The goal of this research is to examine the study done by Seligman et al. titled *Food Insecurity is Associated with Diabetes Mellitus: Results from the National Health Examination and Nutrition Examination Survey (NHANES) 1999-2002*, and apply their techniques to more recent data. The main focus of this research will be looking at the relationship between food insecurity and diabetes, and also food insecurity and obesity. Through this study we want to explore the relationships and see if there are any significant correlations between the variables.

Methods

Data were taken from the most recent available set of data, 2013-2014, from the NHANES website. In an effort to replicate the work of Seligman et al., the data that were collected and the analysis of this data were closely related to the report published in 2007. The data that were collected included self-reported responses as well as laboratory results. For our results to be more accurate, pregnant women, children under the age of twenty, and those with a family income 300% of the federal poverty level were all eliminated from our data set. Pregnant women were excluded because their BMI would not be an accurate representation of their true BMI. Children under the age of twenty were excluded because the presence of diabetes would most likely be type 1 diabetes instead of type 2 diabetes, which is what we are interested in analyzing. Finally, participants with a family income 300% of the federal poverty level were excluded because they were not expected to be food insecure.

Food Security Categorization

The questionnaire portion of the NHANES data included a variety of questions asking participants to submit answers that encompassed a general overview of their life. Specifically looking at the food security section, questions included the participant's access to food stamps, how often they were worried they would run out of food, and their food security level. One of the questions asked the participant to rank how true, or not true, the following statement was, "The food that {I/we} bought just didn't last, and {I/we} didn't have the money to get more" (NHANES). The food security level was determined based on responses from seven questions from the questionnaire section. For each question, the answers were dichotomously determined to be either a "food secure" or a "food insecure" response based on the content of the question. Food secure responses were coded as 0, and food insecure responses were coded as 1. To determine a food security score, the answers to the seven questions were summed and they were given a value between 0 and 7. Those with a score of 0 were labeled "food secure," 1-3 were labeled "mildly food insecure," and finally 4-7 were labeled "severely food insecure."

Other Variables

The other variables that were used included age, gender, race/ethnicity, BMI, income ratio to poverty level, presence of diabetes, highest education level, fasting glucose level (mg/dL), and physical activity (both work and recreation). Some of these questions were self-reported as different categories. Race/ethnicity was self-reported as either Non-Hispanic White, Non-Hispanic Black, Mexican American, Other Hispanic, and Other/Multiple. Highest education level had three categories: "less than high school," "high school," or "more than high school." Body mass index was calculated using the self-reported height and weight measurements. NHANES calculated the ratio of family income to the poverty line using responses from self-

reported income. As mentioned earlier, participants whose income was three times the federal poverty level were excluded. Incidence of diabetes was based on the response to the question asking the participants if a doctor had ever told them that they have diabetes. The fasting glucose level of participants was also taken into account, as those above 126 mg/dL are considered diabetic. This level is used because it is consistent throughout the medical community (Mayo Clinic Staff 2014). Physical activity was based on the responses to four questions that asked the level of physical activity the participants participated in at work and recreationally. These questions focused on moderate and vigorous activity. Finally, obesity was categorized based on the calculated BMI, which is defined at or above 30 kg/m².

Statistical Methods

NHANES provided information on the weighting and variance estimate procedures, which were utilized in SAS 9.3. The *proc survey* command was used to adjust for the complex survey data, and a significance level of 0.05 was used.

The SAS 9.3 *proc surveyfreq* command was used to analyze the baseline characteristics for categorical variables (gender, race/ethnicity, income to poverty ratio, education level, diabetes, physical activity, and food security status). The SAS 9.3 *proc surveyreg* command was used to analyze continuous variables (age and BMI).

Three linear regression models were run to determine if there was a relationship between food insecurity and diabetes, and these tests all used the SAS 9.3 *proc surveylogistic* command. The first model was unadjusted. The second model adjusted for age, gender, race/ethnicity, food security, ratio of income to poverty line, education level, and physical activity. The final model

adjusted for all the previously mentioned variables and included BMI. When determining p-values for the models, a chi-square test was utilized.

To determine the association between food security and obesity, an additional regression model was run using the SAS 9.4 *proc surveylogistic* command. Men and women were modeled separately. This model adjusted for age, gender, income to poverty ratio, physical activity, race/ethnicity, education level, and BMI. When determining p-values for the model, a chi-square test was used.

Results

From the 2013-2014 wave of data, the final survey dataset included 1725 males and 1925 women. Recall that the data excluded women who were pregnant, children under the age of 20, and those with an income to poverty ratio of 300%. Those who did not provide responses to the demographic questions and medical information of interest were also eliminated.

From the seven questions that were used to categorize food security levels, anything with a low response rate was omitted from analysis. The participants were categorized as follows: 24.74% were severely food insecure, 31.11% were mildly food insecure, and 44.15% were food secure.

Age varied significantly ($p < 0.0001$) between the different food security categories, although there was a general trend of food security increasing with age. Race/ethnicity and BMI also varied significantly. Participants who identified themselves as "Non-Hispanic White" had the highest percentage of those labeled food secure, comprising 65.76% of those that stated they were food secure. Those that identified as "Other Hispanic" had the lowest percentage labeled as food secure, only 6.61%. It is also worth mentioning that 18.24% of those labeled severely food

insecure were participants who identified themselves as “Mexican American,” and 17.66% were “Non-Hispanic Black.”

The association between the three levels of food security (food secure, mildly food insecure, and severely food insecure) and diabetes was evaluated first. The association was first evaluated using a chi-square test where the model was unadjusted. The null hypothesis stated that there was no association between the three levels of food security and diabetes. The alternative hypothesis stated that there was an association between the three levels of food security and diabetes. The results of the regression analysis have been summarized in table 1.

Table 1

Association Between the Three Levels of Food Security and Diabetes Using NHANES 2013-2014 Data

	Unadjusted		Adjusted I		Adjusted II	
	Odds Ratio (95% CI)	P (overall=0.62)	Odds Ratio (95% CI)	P (0.008)	Odds Ratio (95% CI)	P (0.047)
Food Secure	1		1		1	
Mild Food Insecure	1.124 (0.89,1.42)	0.33	1.564 (1.16,2.11)	0.0033	1.545 (1.08,2.21)	0.017
Severe Food Insecure	1.114 (0.78,1.60)	0.55	1.665 (1.06,2.62)	0.027	1.476 (0.90,2.41)	0.12

Before individually analyzing the different levels of food security, it was important to know the impact of food security as a whole. Looking at the unadjusted model, the p-value was 0.6188. This suggests that the three levels of food security were not associated with diabetes when using $\alpha=0.05$ ($p>\alpha$). Adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education, however, the calculated p-value was 0.0084. Since $p<\alpha$, there was an association between the three levels of food security and diabetes after adjusting for these variables. Finally, looking at the overall p-value of the model after adjusting for the variables mentioned above as well as BMI, the p-value was 0.0474. Thus $p<\alpha$, which suggests that there was an association between all of the previously mentioned variables and diabetes.

When observing the unadjusted mild food insecurity model, the p-value was 0.3326. Using $\alpha=0.05$, it can be seen that $p>\alpha$, so we fail to reject the null hypothesis. An odds ratio of 1.124 (95% CI: 0.89, 1.42) suggests that being mildly food insecure increases the chances of getting diabetes by 1.124 times compared to someone that is food secure. However, since we failed to reject the null hypothesis, there was no association between mild food insecurity and diabetes.

The unadjusted severe food insecurity model obtained a p-value of 0.5520. With $\alpha=0.05$, it can be seen that $p>\alpha$, so we failed to reject the null hypothesis. An odds ratio of 1.114 (CI: 0.78, 1.60) suggests that being severely food insecure increases the chances of getting diabetes by 1.114 times compared to someone that is food secure. However, since we failed to reject the null hypothesis, there was no association between severe food insecurity and diabetes.

Different results are obtained when adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education. To evaluate the association between the three levels of food security and diabetes in the adjusted model, a chi-square test was used. The null

hypothesis stated that there was no association between the three levels of food security and diabetes after adjusting for the previously mentioned variables. The alternative hypothesis stated that there was an association between the three levels of food security and diabetes after adjusting for the previously mentioned variables.

The adjusted mild food insecurity test obtained a p-value of 0.0033. Using $\alpha=0.05$, it was observed that $p<\alpha$, so we rejected the null hypothesis. Thus, there was an association between mild food security and diabetes after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education. Since the odds ratio was 1.564 (95% CI: 1.16, 2.11), we see that being mildly food insecure increased the chances of getting diabetes by 1.564 times compared to someone who was food secure, after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education.

The results for the adjusted severe food insecurity model indicated that the p-value was 0.0267. With $\alpha=0.05$, $p<\alpha$, so we rejected the null hypothesis. Therefore, there was an association between food security and diabetes after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education. The odds ratio of 1.665 (95% CI: 1.06, 2.62) suggests that being severely food insecure increased the chances of getting diabetes by 1.665 times compared to someone who was food secure after adjusting for the previously mentioned variables.

Finally, a chi-square test was used to evaluate the association between the three levels of food security and diabetes after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, education, and BMI. Note, now BMI has been added to the list of adjusted variables. The null hypothesis stated that there was no association between the three levels of food security and diabetes after adjusting for the previously mentioned variables. The

alternative hypothesis stated that there was an association between the three levels of food security and diabetes after adjusting for the previously mentioned variables.

The adjusted test for mild food insecurity obtained a p-value of 0.0172. With $\alpha=0.05$, it can be seen that $p<\alpha$, so we rejected the null hypothesis. Thus, there was an association between mild food insecurity and diabetes after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, education, and BMI. Since the odds ratio was 1.545 (95% CI: 1.08, 2.21), it suggests that being mildly food insecure increased the chances of getting diabetes by 1.545 times compared to someone who was food secure after adjusting for the previously mentioned variables.

The adjusted test for the severe food insecurity model obtained a p-value of 0.1195. With $\alpha=0.05$, $p>\alpha$, so we failed to reject the null hypothesis. The odds ratio was 1.476 (95% CI: 0.90, 2.41), which suggested that being severely food insecure increased the chances of getting diabetes by 1.476 times compared to someone who was food secure, after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, education, and BMI. However, since we failed to reject the null hypothesis, there was no association between severe food insecurity and diabetes after adjusting for the previously mentioned variables.

Next, the association between the three levels of food security and obesity was observed, after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education, and then stratifying by gender. The Wald chi-square statistic was used when determining the significance of the association. The null hypothesis stated that there was no association between the three levels of food security and obesity after adjusting for the previously mentioned variables and stratified by gender. The alternative hypothesis stated that there was an association between the three levels of food security and obesity after adjusting for

the previously mentioned variables. The results for the regression analysis have been summarized in table 2.

Table 2

Association Between the Three Levels of Food Security and Obesity, Stratified by Gender,
Using NHANES 2013-2014 Data

	Women		Men overall	
	Odds of Obesity (95% CI)	p (0.008)	Odds of Obesity (95% CI)	p (0.3925)
Food Secure	1		1	
Mild	1.145 (0.93,1.41)	0.2050	1.207 (0.82,1.79)	0.3457
Food Insecure	1.815 (1.25,5.64)	0.0019	1.325 (0.91,1.92)	0.1374

Observing the overall data for women, the p-value was 0.0078. With $\alpha=0.05$, it can be seen that $p < \alpha$, so we rejected the null hypothesis. This suggests that there was an association between the three levels of food security and obesity among women.

Mild food insecurity and obesity was first analyzed. A p-value of 0.2050 was obtained, and so $p > \alpha$. Thus, we failed to reject the null hypothesis. The odds ratio was 1.145 (95% CI: 0.93, 1.41), which suggests that being mildly food secure increases the chances of being obese by 1.145 times in women after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education. However, since we failed to reject the null hypothesis,

there is no association between mild food insecurity and obesity in women after adjusting for the previously mentioned variables.

The adjusted model for severe food insecurity and obesity obtained a p-value of 0.0019. With $\alpha=0.05$, $p<\alpha$ so we rejected the null hypothesis. This suggests that there was an association between severe food insecurity and obesity among women after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education. The odds ratio was 1.815 (95% CI: 1.25, 5.64) which suggests that there was an increase in the chances of obesity in women by 1.815 times after adjusting for the previously mentioned variables.

Looking at men overall, the p-value was 0.3295. Using $\alpha=0.05$, $p>\alpha$, so we failed to reject the null hypothesis. This suggests that there was not an association between the three levels of food security and obesity among men.

Mild food insecurity and obesity were compared first among men. The p-value was 0.3295. With $\alpha=0.05$, it can be seen that $p>\alpha$, so we failed to reject the null hypothesis. The odds ratio was 1.207 (95% CI: 0.82, 1.79) which suggests that being mildly food secure increases the chances of being obese by 1.207 times in men compared to a man that is food secure, after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education. However, since we failed to reject the null hypothesis, there is no association between mild food security and obesity in men after adjusting for the previously mentioned variables.

The model of men that were severely food insecure produced a p-value of 0.1374. With $\alpha=0.05$, $p>\alpha$, so we rejected the null hypothesis. This suggests that there was not an association between severe food insecurity and obesity among men after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education. The odds ratio was 1.325 (95% CI: 0.91, 1.92) which suggests that being severely food insecure increases the chances of being

obese by 1.325 times in men compared to men that are food secure, after adjusting for the previously mentioned variables. However, since we failed to reject the null hypothesis, there is no association between food insecurity and obesity among men after adjusting for the previously mentioned variables.

Conclusion

Overall, it was concluded that there was a significant association between the three levels of food security and diabetes after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education. This significance remained when adjusting for the previous variables and including BMI. There was also a significant association between mild food insecurity and diabetes, as well as an association between severe food insecurity and diabetes after adjusting for age, gender, income to poverty ratio, physical activity, race/ethnicity, and education. There again was a significant association between mild food insecurity and diabetes after adjusting for the previously mentioned variables and BMI.

When stratifying between males and females, there was an association between the three levels of food security and obesity among women after adjusting for age, gender, income to poverty ratio, physical education, race/ethnicity, and education. There was not an association among men. There was also a significant association specifically looking at food insecurity and obesity among women after adjusting for the previously mentioned variables. It is important to note that all other associations were not significant.

The study conducted by Seligman et al. in 2007 found that food insecurity was independently associated with diabetes. My analysis, using data from 2013-2014, found a statistically significant association between food insecurity and diabetes after adjusting for age,

gender, income to poverty ratio, physical activity, and education. The original study also suggested that the association between food insecurity and diabetes was independent of BMI. In the current study, there was a significant association between mild food security and diabetes after adjusting for all of the listed covariates and BMI. There was also evidence of an association between obesity and food insecurity in women that Seligman et al. found. These results showed evidence that obesity was associated with an increased risk of being food insecure.

Although the results were not identical to Seligman et al, there could be a variety of factors leading to that conclusion. First, the original research used two years of data to produce their results, 1999-2002, so this could have had an effect on the responses. The NHANES questions have also changed in the past 15 years, so that could have also affected the outcome. It could also be beneficial to recreate the results from the 1999-2002 data to make sure a proper metric for dividing the food security categories is utilized.

If someone were given the opportunity to recreate this project, start by analyzing the 1999-2002 data sets prior to analyzing the 2013-2014 data set, as stated above. The analysis of the association between food insecurity and depression would also be an interesting addition to this project. One would think that families dealing with severe food insecurity would likely be overcome with more anxiety and depression as they try to keep them and their families fed. More research on food deserts and research on correlations between location and food insecurity would be beneficial as well. There are probably many more factors that affect food security, and it would be interesting to expand on the research already being done by NHANES.

Works Cited

- Delaware County, Indiana*. United States Census Bureau,
www.factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml#. Accessed 30
March 2018.
- Eating Healthy vs. Unhealthy Diets Cost About \$1.50 More per Day*. Harvard T.H. Chan: School
of Public Health, 5 Dec. 2013, www.hsph.harvard.edu/news/press-releases/healthy-vs-unhealthy-diet-costs-1-50-more/. Accessed 29 March 2018.
- Key Statistics and Graphics*. United States Department of Agriculture Economic Research
Service, 4 Oct. 2017, www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx. Accessed 14 February 2018.
- Mayo Clinic Staff. *Diabetes*. Mayo Clinic, 31 July 2014, www.mayoclinic.org/diseases-conditions/diabetes/basics/tests-diagnosis/con-20033091. Accessed 29 March 2018.
- National Health and Nutrition Examination Survey*. CDC/National Center for Health Statistics.
www.cdc.gov/nchs/nhanes/continuousnhanes/default.aspx?BeginYear=2013. Accessed 8
Jan. 2018.
- Pietrangelo, Ann and Kristeen Cherney. *The Effects of Diabetes on Your Body*. Healthline, 28
June 2017, www.healthline.com/health/diabetes/effects-on-body#1. Accessed 30 March
2018.
- Seligman, Hilary K. et al. *Food Insecurity Is Associated with Diabetes Mellitus: Results from the
National Health Examination and Nutrition Examination Survey (NHANES) 1999–2002*.
Journal of General Internal Medicine 22.7 (2007): 1018–1023. PMC. Web. 8 Jan. 2018.